PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Improvements in and relating to Suspension Systems for Vehicles

We, SOCIETE ANONYME ANDRE CITROEN, a French Body Corporate, of 117—167, Quai de Javel, Paris (Seine Department), France, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

Our invention has for its its object an improved differentially interacting suspension for vehicles. It is known that such differentially interacting suspension means considerably improve comfort; several suspensions of such a type have already been proposed, in particular a suspension including a resilient member which acts on an inclined lever or levers of variable effective length so that the moment of the forces exerted on them may vary in proportion with the movements of the corresponding wheel with a view to compensating for the variations in the distribution of the load, whether static or dynamic, between the front and rear suspension.

It has also been proposed to execute a connection between the front and rear suspensions without any variation in the lever arm through which each suspension acts, however with the use of an additional resilient element bearing on the frame. Now applicants have found that for a proper interaction between the front and rear suspension of a vehicle, it is necessary to provide for the following conditions):—

i) the interaction should be executed between the front and rear wheel on the same side and the suspension should be applied to each side of the vehicle;

ii) the connections should be such that when one wheel experiences an upward deflection, the interconnected wheel is forced downwardly, and *vice versa*;

iii) no transverse interaction between the suspensions should be allowed;

iv) the yielding connections of the system should not bear at any point on the chassis of the vehicle;

v) the interacting system should be complete in itself and be associated with no further suspension means;

vi) the system should always find a position of equilibrium whatever may be the distribution of the load.

Applicants have found that the above conditions may be simultaneously satisfied by the arrangement according to the invention with a differential action between individual wheels on one side of a vehicle that provides for submitting each wheel to the action in the same direction of a couple of springs or the like resilient connections acting in parallel between the wheels on the respective side of the vehicle and having no bearing point on the chassis, one of the springs of each couple acting on the front wheel and the other on the rear wheel of the side considered through the agency of lever arms, the moment arm of one spring of the couple being stronger in respect of the front lever arm than in respect of the rear while conversely the moment arm of the other spring of the couple is stronger at the rear than at the front.

The following description with reference to the accompanying diagrams shows more clearly the arrangement according to the invention.

Fig. 1 is a diagram in which only the two wheels on the same side of a vehicle have been shown and in which the resilient elements are represented in the form of two coil springs.

Fig 2. shows a hydraulic suspension based on the same principle.

Figs. 3 and 4 show modifications.

In Fig. 1, the spring R is connected to the suspension lever of the front wheel at point A and to the lever of the rear wheel at point B^1. The spring R^1 is connected at the front at point B and at the rear at point A^1. The spring R therefore acts on a lever arm which is greater in front than at the rear, whilst for spring R^1, it is the reverse.

In a suspension thus executed the

[*Price* 1/-]

Price 4s 6d.

system always automatically finds a position of balance, whatever be the distribution of the load, provided however that the ratio of the loads between front and rear remain within prescribed limits, such limits being fixed by the relative dimensions of all the lever arms and by the characteristics of the springs R and R^1.

In such a system, the greater the ratios OA/OB and O^1A^1/O^1B^1, the greater is the range within which the ratio between the loads on the front and rear wheels may vary and the lesser is the variation of the longitudinal distribution for a given variation of load distribution.

Whatever be the vehicle and the variations in the load ratio between the front and rear wheels, a value for the ratios OA/OB and O^1A^1/O^1B^1 and characteristics of the springs R and R^1 can always be found in order that a position of equilibrium may always be found within the range of operation.

Figs. 2 and 3 show similar embodiments of the same principle incorporating hydraulic transmissions. The springs R R^1 of Fig. 1 are replaced by corresponding capacities containing a compressed gas C C^1. The pressure of the compressed gas contained in the capacity C is transmitted through the pipe T to the pistons P and P^1 acting respectively on the points A and B^1 of the suspension arms for the front and rear wheels (Fig. 2). Similarly the pressure of the gas contained in C^1 acts through the pipe T^1 on the pistons M and M^1 connected with the points B and A^1 of the rear and front suspension levers.

Comparing Fig. 2 with Fig. 1, only the elastic elements are different. Their action on the suspension arm is identical and the operation is the same.

In Fig. 2, the four pistons are illustrated as equal and acting on different lever arms but as the moment of the i.e. the product of the value of the force multiplied by the length of the lever arm is alone of interest, it is apparent that it is possible to modify the position of points A B A^1 B^1 provided the surfaces of the pistons P M P^1 M^1 are calculated in a manner such that the products of said surfaces by the distance between their connecting point and the pivot O O^1 may be equal.

This possibility afforded by hydraulic transmission allows executing the suspension under the form illustrated in Fig. 3, wherein each wheel is connected with a differential piston providing an annular operative surface P and a relatively smaller circular surface M for the front chamber and conversely an annular surface M^1 and a smaller circular surface P^1 for the rear chamber.

The elastic capacity C is hydraulically connected with the larger surface P to the front and with the smaller surface P^1 to the rear while the capacity C^1 is connected with the larger surface M^1 to the rear and to the smaller surface M to the front, the result obtained through said suspension is the same as that obtained in the case of Fig. 2.

As a modification of Fig. 3, it is possible to adopt the arrangement disclosed in Fig. 4. In the latter, the differential pistons showing surfaces P, M, P, M^1, as precedingly are arranged centrally in close proximity with the elastic capacities C and C^1. The latter are connected hydraulically with said surfaces in the same manner as in the case of Fig. 3. The resultant of the forces acting on surfaces M and P is transmitted to the outer surface S of the same piston and similarly the resultant of the forces acting on M^1 and P^1 is transmitted to the outer surface S^1. The pressure prevailing at S may thus be transmitted to a piston U acting on the front lever and similarly the pressure prevailing at S^1 is transmitted to the rear piston U^1, in order to obtain the same result as that obtained with the arrangement in Figs. 2 and 3. The principle of the three modifications illustrated in Figs. 2, 3 and 4 is the hydraulic replica of the mechanical solution shown in Fig. 1 and operates in exactly the same manner.

In all the diagrams, the wheels are shown as being mounted on arms moving in a longitudinal plane but the suspension is applicable to any other mode of connection between the wheels and the chassis within the scope of the invention as defined in the accompanying claims.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A suspension with a differential interaction between individual wheels on one side of a vehicle, wherein each wheel is submitted to the action in the same direction of a couple of springs or the like resilient connections acting in parallel between the wheels on the respective side of the vehicle and having no bearing point on the chassis, one of the springs of each couple acting on the front wheel and the other on the rear wheel of the side considered through the agency of lever arms, the moment arm of one spring of the couple being stronger in respect of the front lever arm than in respect of the rear, while conversely the moment arm of the other spring of the couple is stronger at the rear than at the front.

2. A suspension as claimed in claim 1, wherein one spring of each couple acts on the outer end of a suspension lever co-operating with the corresponding front wheel and with a point that is comparatively near the oscillation axis of a suspension lever for the corresponding rear wheel, while the other spring on the same side of the vehicle connects a point located near the oscillation axis of the first suspension lever with a point near the outer end of the second suspension lever.

3. A suspension as claimed in claims 1 and 2, wherein the springs comprise hydro-pneumatic connections constituted by two compressed fluid pipes each connecting a respective compression chamber with a respective pair of chambers closed by pistons, the piston rods of which are respectively connected with the outer end of the front suspension lever and with a point near the oscillation axis of the rear suspension lever in respect of one of the pipes and conversely for the other pipe.

4. A modification of the suspension as claimed in claim 3, wherein each of the two pipes open at each end into a chamber closed by a differential piston, the rod of which is positively connected with the corresponding front or rear suspension lever, one of the pipes being connected at one end to a piston portion of larger area of one of the differential pistons and at the other end to a piston portion of smaller area of the other differential piston, the second pipe being connected conversely.

5. A further modification of the arrangement claimed in claim 3, wherein hydraulic pipes are connected respectively at one end with respective chambers, each having a piston which is positively connected with the lever of the corresponding wheel, while the other ends of the pipes are connected with respective chambers closed by differential pistons, the larger and smaller operative surfaces of one of which is connected hydraulically with the smaller and larger operative surfaces, respectively, of the other differential piston.

6. A suspension system having differential interaction between individual wheels on one side of a vehicle, substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

Dated this 3rd day of April, 1945.

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Fig.1.

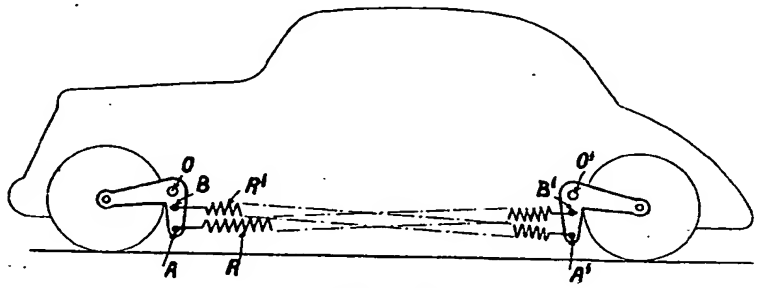


Fig.2.

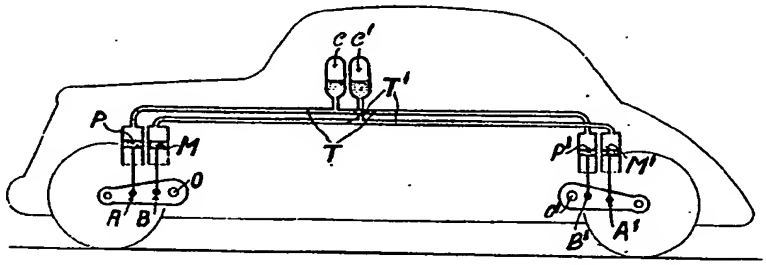


Fig.3.

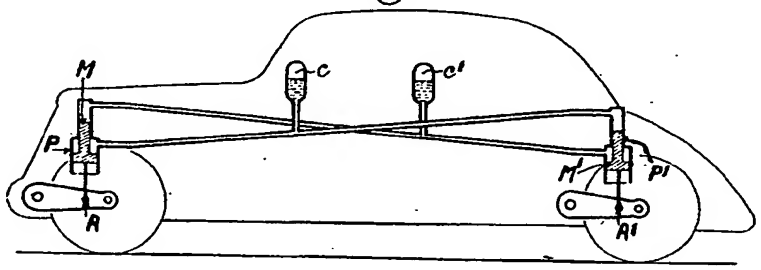
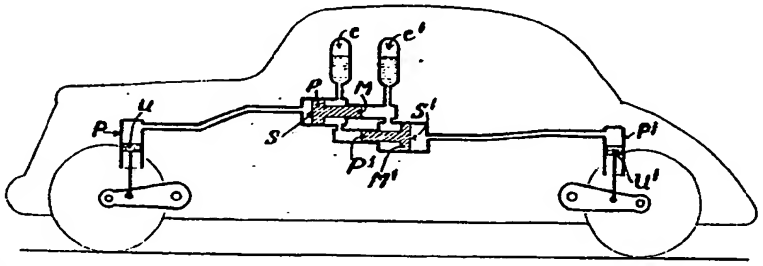


Fig.4.



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